ORGANIC LIGHT EMITTING DISPLAY DEVICE

BACKGROUND OF THE INVENTION

1. Field of the Invention:

The present invention relates to an organic light emitting display device, and more particularly to an organic light emitting display device which can enhance the brightness by increasing the utilization efficiency of an emitted light.

2. Description of the Related Art:

Recently, as one of next-generation flat type display devices, a display device which uses organic light emitting elements has been attracting attentions. The display device using these organic light emitting elements (hereinafter referred to as an organic light emitting display device) has excellent characteristics such as a self-luminescent light, a wide viewing angle and rapid response characteristics. The structure of the conventional organic light emitting element is constituted of a transparent substrate which is preferably made of glass, first electrodes made of ITO or the like which are formed on the transparent substrate, an organic light emitting layer constituted of a hole transporting layer, light emitting layer and an electron transporting layer and the like which is stacked on the first electrodes, and second electrodes having a low work function which are formed on the organic light emitting layer. By applying a voltage of approximately several V between the first electrode and the second electrode, holes and electrons are respectively injected into respective electrodes and they are coupled in the light emitting layer after passing through the hole transporting layer and the electron transporting layer respectively thus generating excitons and light is emitted when these excitons return to a ground state. In a so-called bottom-emission-type organic light emitting display device which uses the transparent electrode as the first electrode and a reflection electrode as the second electrode, the emitted light passes through the first electrode and is taken out from the transparent substrate side.

Fig. 6 is a cross-sectional schematic view for explaining a constitutional example of an organic light emitting element of one pixel constituting the bottom-emission type organic light emitting display device. The organic light emitting display element is constituted of a multilayered structural film in which a lower transparent electrode (hereinafter referred to as an anode EA) which constitutes a first electrode and usually becomes an anode is formed on a transparent substrate SUB which is preferably made of glass, an organic light emitting layer OLE which is constituted of a hole transporting layer, a light emitting layer and an electron transporting layer is stacked over the anode EA, and an upper reflection electrode (hereinafter referred to as a cathode EK) which forms a second electrode and usually becomes a cathode is stacked over the organic light emitting layer OLE. Here, reference symbols INS1, INS2 indicate insulation layers and these insulation layers are usually formed of an inorganic insulation material such as silicon nitride (SIN) or the like. Then, the multilayered structural film is shielded from an environment using a shield plate SB thus suppressing the degradation of the organic light emitting layer OLE attributed to the intrusion of moisture or the like.

The organic light emitting display device using such an organic light emitting element as a pixel portion is classified into a single-matrix-type organic light emitting display device and an active-matrix-type organic light emitting display device. In the single-matrix-type organic light emitting display device, multilayered structural films each of which is constituted of a hole transporting layer, a light emitting layer, an electron transporting layer and the like are formed at positions where a plurality of anode lines (also referred to as anode wiring) and a plurality of cathode lines (also referred to as cathode wiring) intersect each other and each pixel is turned on or lit only during the selection time within 1 frame period. The above-mentioned selection time is a time width which is obtained by dividing the 1 frame period with the number of anode lines. The simple-matrix-type organic light emitting display device has an advantage that the display device has the simple structure.

However, when the number of pixels is increased, the selection time is shortened. Accordingly, it is necessary to increase the instantaneous brightness during the selection time by increasing a driving voltage thus setting the average brightness during 1 frame period to a given value. In this case, however, there arises a drawback that a lifetime of the organic light emitting element is shortened. Further, since the organic light emitting element is driven by a current and hence, particularly with respect to the organic light emitting display device having a large screen, a wiring length of the anode lines and the cathode lines is elongated and hence, a voltage drop attributed to the wiring resistance is generated whereby the voltage cannot be uniformly applied to respective pixels. As a result, the in-plane brightness irregularities occur in the display device. Due to these reasons, there exists a limit with respect to the high definition and the acquisition of large screen in the single-matrix-type organic light emitting display device.

On the other hand, the active-matrix-type organic light emitting display device has the structure in which a pixel drive circuit which is constituted of 2 to 4 pieces of active elements such as thin film transistors or the like and a capacitance is connected to the organic light emitting element which constitutes each pixel and, further, a power source line which supplies an electric current to the organic light emitting element is provided thus enabling lighting of all pixels within 1 frame period. Accordingly, it is not necessary to increase the brightness and hence, a lifetime of the organic light emitting element can be prolonged. Due to such reasons, it is considered that the active matrix-type organic light emitting display device is advantageous with respect to the acquisition of the high definition and the large-sizing of the display screen. Although the explanation is made by using the thin film transistor as the active element hereinafter, it is needless to say that other active elements can be used.

As mentioned previously, the active-matrix-type organic light emitting display device of a type which takes out the emitted light from the transparent substrate side is

also referred to as the bottom-emission-type organic light emitting display device. In the organic light emitting display device of this type, when the pixel drive circuit is provided between the transparent substrate and the multilayered structural film which constitutes the organic light emitting element, the pixel drive circuit interrupts the emitted light of the organic light emitting element and hence, a so-called numerical aperture is limited. Particularly, when the display device adopts a large screen, to reduce the brightness irregularities between the pixels attributed to the voltage drop between power source lines, it is necessary to widen a width of the power source lines and hence, the numerical aperture becomes small. Further, when an attempt is made to increase the capacitances for holding a bias voltage and a signal voltage of the thin film transistor which drives the organic light emitting element, an area of the capacitance electrode is increased and hence, the numerical aperture is decreased. Further, in the conventional organic light emitting display device, the utilization efficiency of light emitted from the light emitting layer is insufficient and hence, it is difficult to acquire the high brightness.

A patent gazette the inventors of the present patent application referred is identified as follows.

Patent Document 1: Japanese Unexamined Patent Publication 1998-208875.

SUMMARY OF THE INVENTION

Fig. 7 is an enlarged view of a portion indicated by an arrow A in Fig. 6 for explaining an irradiation state of an emitted light in an organic light emitting element which constitutes the conventional organic light emitting display device. In Fig. 7, the multilayered structural film which is constituted of the lower transparent electrode (anode EA), the organic light emitting layer OLE and the upper reflection electrode (cathode EK) and is formed on the transparent substrate SUB is formed to provide a planer surface parallel to a surface of the transparent substrate SUB. That is, with

respect to the emitted light from a point P of the organic light emitting layer OLE in Fig. 7, a light Lm which is directly irradiated from the transparent substrate SUB and a light Lr which is reflected on the upper reflection electrode EK and is irradiated from the transparent substrate SUB are used for display. However, a light Lf which is irradiated in the direction parallel (including "approximately parallel", applicable to the description made hereinafter in the same manner) to the transparent substrate SUB is not used for display and is wasted.

Since the organic light emitting layer OLE in the pixel portion is parallel to the surface of the transparent substrate SUB, a light emitting area is defined by an area of the pixel portion whereby it is necessary to increase a current quantity to increase the brightness of the emitted light of the organic light emitting layer OLE. However, when the current quantity is increased, the degeneration of an organic material which constitutes the multilayered structural film attributed to an electrochemical reaction is promoted thus shortening a lifetime of the multilayered structural film.

To increase the area of the organic light emitting layer OLE, as described in the "patent document 1", there has been proposed a technique which forms a surface of a transparent substrate in a convex shape by forming the surface using a solvent. However, in the "patent document 1", in a dissolving step of a substrate forming process which uses the solvent, there exists a possibility that the organic light emitting layer is contaminated and hence, it is difficult to ensure the reliability of the organic light emitting layer.

Accordingly, it is an object of the present invention to provide an organic light emitting display device using organic light emitting elements of a low current and the high brightness which can be realized by the structure in which an area of a light emitting portion made of an organic light emitting layer is made wider than an area of a pixel portion thus enlarging the effective area of a light emitting portion and a light from the organic light emitting layer is effectively taken out to a transparent substrate side.

To achieve the above-mentioned object, the organic light emitting display device according to the present invention is characterized by the structure in which in a multilayered structural film of an organic light emitting element thereof which is constituted by sandwiching an organic light emitting layer between a lower transparent electrode and an upper reflection electrode, one or plurality of concavities (for example, at least a portion of an interface between the lower transparent electrode and the organic light emitting layer forming a concave surface with respect to the transparent substrate) are formed, and an organic insulation film is filled in the concavities. That is, with respect to the organic light emitting element which constitutes the organic light emitting display device of the present invention, a plurality of pixel portions which are constituted of the organic light emitting elements which are arranged in a matrix array on the transparent substrate and pixel drive circuits which have active elements such as thin film transistors for driving the organic light emitting elements are formed in a matrix array. In other words, in a plurality of respective pixel regions formed in the organic light emitting display device, at least one concave lens is formed in a light emitting surface of the organic light emitting layer facing the transparent substrate (for example, an interface between the lower transparent electrode and the organic light emitting layer). The concave lens is formed such that the concave lens is housed in the inside of an opening of a bank portion of an insulation layer which partitions a plurality of pixel regions.

The above-mentioned organic light emitting element is configured such that the organic light emitting element includes a large number of light emitting regions arranged in a matrix array, wherein each light emitting region constitutes a pixel portion for each pixel unit formed of a multilayered structural film which is constituted of a lower transparent electrode formed at the transparent substrate side, the organic light emitting layer, and an upper reflection electrode formed above the organic light emitting layer, and an emitted light from the organic light emitting layer is taken out from the lower

transparent electrode side through the transparent substrate. Further, the above-mentioned multilayered structural film has concavities which are recessed at the transparent substrate side in the inside of the pixel portion and a plurality of projecting portions which project at a side opposite to the transparent substrate. A transparent organic insulation layer is arranged between the above-mentioned concavities of the projecting portions and the transparent substrate.

By forming a shape of the concavities such that the concavities have open peripheries at the transparent substrate side and have a cross section along a surface perpendicular to the transparent substrate which has a bowl shape or a shape similar to the bowl shape (a turn-over bowl shape, for example, a bowl shape having an elliptical, polygonal, irregular open peripheries, hereinafter referred to as the bowl shape including these shapes), a light emitting area can be made larger than an area of the pixel portion. Further, the emitted light from the organic light emitting layer which constitutes the multilayered structural film can, besides the light which is directly irradiated in the direction toward the transparent substrate, also direct the light which is reflected on an inner surface of the bowl-shaped upper reflection electrode in the direction toward the transparent substrate. Further, the shape of the concavities may be formed such that the concavities have oblique surfaces which are gradually enlarged and opened from peripheries of a flat center portion toward the transparent substrate side thus forming a cross section along a surface perpendicular to the transparent substrate which has a trapezoidal shape or a shape similar to the trapezoidal shape (hereinafter referred to as the trapezoidal shape including these shapes). In this manner, by forming the shape of the concavities into a combined shape of the bowl shape and the trapezoidal shape, the emitted light from the organic light emitting layer which constitutes the multilayered structural film can, besides the light which is directly irradiated in the direction toward the transparent substrate, also direct the light which is reflected on an inner surface of the upper reflection electrode having the trapezoidal shape or a combined shape of the bowl

shape and the trapezoidal shape in the direction toward the transparent substrate.

Further, by forming a transparent-substrate-side end peripheries of the concavities such that such end peripheries do not extend beyond end peripheries of the light emitting region of the pixel portion, it is possible to prevent leaking of light in the direction parallel to the transparent substrate from the open peripheries and oblique surfaces of the concavities and hence, the substantially whole emitted light can be taken out in the transparent substrate direction whereby the utilization efficiency of the emitted light can be enhanced.

Accordingly, the light emitting area of the pixel portion can be substantially enlarged and hence, the emitted light having the high brightness can be taken out from the transparent substrate side with a low electric current whereby the long lifetime can be ensured by suppressing an electrochemical reaction of the organic light emitting layer which is caused by the increase of an electric current quantity required for obtaining the high brightness in the conventional structure.

Here, it is needless to say that the present invention is not limited to the above-mentioned constitutions and constitutions which are explained in conjunction with embodiments described later and various modifications are conceivable without departing from the technical concept of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a plan view of an essential part in the vicinity of one pixel of an organic light emitting element constituting an organic light emitting display device for explaining the first embodiment of the present invention;

Fig. 2 is a cross-sectional view taken along a line A-A' in Fig. 1;

Fig. 3 is a cross-sectional view for explaining the irradiation of emitted light from the organic light emitting layer by enlarging one projecting portion in Fig. 2;

Fig. 4 is a cross-sectional view similar to Fig. 3 for explaining an essential part of a portion in the vicinity of one pixel of the organic light emitting element constituting the organic light emitting display device for explaining the second embodiment of the present invention;

Fig. 5 is an explanatory view of an example of an equivalent circuit of one pixel of the organic light emitting element to which the present invention is applied;

Fig. 6 is a cross-sectional schematic view for explaining an example of the structure of an organic light emitting element of one pixel constituting a bottom-emission-type organic light emitting display device; and

Fig. 7 is an enlarged view of a portion indicated by an arrow A in Fig. 6 for explaining an irradiation state of emitted light in an organic light emitting element which constitutes a conventional organic light emitting display device.

DETAILED DESCRIPTION

Embodiments of an organic light emitting display device according to the present invention are explained in detail in conjunction with drawings showing the embodiments hereinafter.

Fig. 1 is a plan view of an essential part in the vicinity of one pixel of an organic light emitting element which constitutes an organic light emitting display device for explaining the first embodiment of the present invention. Further, Fig. 2 is a cross-sectional view taken along a line A-A' in Fig. 1. The organic light emitting display element of this embodiment includes a plurality of mountain-like portions OPAS1 on a transparent substrate SUB side as shown in a cross-section in Fig. 2. These mountain-like portions OPAS1 are formed of a transparent organic insulation layer. Further, a first electrode (an anode in this embodiment, hereinafter referred to as an anode EA) which constitutes a pixel portion PA is formed to cover the mountain-like portions OPAS1. An organic light emitting layer OLE is formed over the anode EA.

Further, a second electrode (a cathode in this embodiment, hereinafter referred to as a cathode EK) is formed over the organic light emitting layer OLE by stacking. The organic light emitting layer OLE is basically constituted such that a hole transporting layer HT, a light emitting layer LM and an electron transporting layer ET are stacked from the anode EA side to the cathode EK side.

In Fig. 2, reference symbols INS1, INS2 indicate insulation layers. These insulation layers INS1, INS2 are usually formed of an inorganic insulation material such as silicon nitride (SiN) and ensures the insulation of data signal lines DL, scanning signal lines GL and power source lines CL as well as the insulation of anodes EA and the cathodes EK and, at the same time, constitute banks for defining boundaries between neighboring pixels at peripheries of pixel portions PA. Further, reference symbol INS3 in Fig. 1 indicates an insulation layer at an intersecting portion of the scanning signal line GL, the data signal line DL and the power source line CL. Emitted light L from the organic light emitting layer OLE is taken out from the transparent substrate SUB in the direction indicated by a large arrow.

As can be understood from a planer shape shown in Fig. 1, a multilayered structural film constituted of the anode EA, the organic light emitting layer OLE and the cathode EK has a shape which traces a surface shape of the above-mentioned mountain-like portion OPAS1 in the inside of the pixel portion PA. In this embodiment, in the inside of the region of the pixel portion PA, the multilayered structural film has concavities PJ1 (also shown in Fig. 3 with a reference symbol ALC1) which are recessed at the transparent substrate SUB side, wherein a plurality (seven pieces) of bowl-shaped projecting portions PJ1 having a turn-over bowl-shape which are projected to a side opposite to the transparent substrate SUB are formed. In this embodiment, one pixel is formed in a region which is surrounded by the data signal line DL which extends in one direction, the scanning signal line GL which extends another direction crossing one direction and the power source line CL which is arranged parallel to the data signal line

DL and extends close to the data signal line DL. At a corner of the pixel portion PA, a pixel drive circuit DVC which is constituted of a thin film transistor is provided.

Fig. 3 is a cross-sectional view for explaining the irradiation of the emitted light from the organic light emitting layer by enlarging one projecting portion shown in Fig. 2. The projecting portion PJ1 of this embodiment is constituted of the mountain-like portion OPAS1 having a bowl shape and is made of a transparent organic insulation material which is formed in the concavity ALC1 having the bowl shape of the multilayered structural film formed of the anode EA, the organic light emitting layer OLE and the cathode EK. The emitted light from one point P of the organic light emitting layer OLE includes a direct light Lm which is directly irradiated from the transparent substrate SUB, a reflection light Lr1 which is irradiated from the transparent substrate SUB after being reflected on the cathode EK which constitutes an upper reflection electrode, and a multiple reflection light Lr2 which is irradiated from the transparent substrate SUB after being reflected a multiple times on the cathode EK and the anode EA which constitutes a lower transparent electrode. In this manner, the substantially whole emitted light from one point P of the organic light emitting layer OLE is taken out from the transparent substrate SUB (absorption of the emitted light by the multilayered structural film, the mountain-like portion OPAS1 or the transparent substrate SUB is not considered. The same being applicable to the description made hereinafter).

Further, as can be clearly understood from the drawing, an area of the organic light emitting portion which is formed between the concavity ALC1 and the projecting portion PJ1 is broadened compared to an area of the conventional light emitting portion explained in conjunction with Fig. 6 and Fig. 7 in which the multilayered structural film of the organic light emitting portion has a planer shape parallel to a surface of the transparent substrate SUB. Accordingly, the area which contributes to the emission of light is substantially enlarged. That is, although the area of the pixel portion PA in a

plan view may be equal, the substantial light emitting area is enlarged and hence, a light emitting quantity of one pixel is increased. Here, although a single projecting portion PJ1 having the concavity ALC1 may be formed in the inside of the pixel, it is preferable to provide a plurality of projecting portions PJ1. Particularly, to prevent the degeneration of the organic light emitting layer OLE caused by undesired substances such as moisture from the organic insulation layer which is formed to fill the concavity ALC1 of the bowl-shaped mountain-like portion OPAS1, it is preferable to form a plurality of small projecting portions PJ1 and to cover these projecting portions PJ1 with the anode EA made of ITO.

In this manner, according to this embodiment, the multilayered structural film which is constituted of the anode EA, the organic light emitting layer OLE and the cathode EK which is formed over the organic light emitting layer OLE is formed such that a plurality of bowl-shaped projecting portions PJ1 which are projected to the side opposite to the transparent substrate SUB while having the concavity ALC1 which is formed to be recessed toward the transparent substrate SUB side are formed in the inside of the pixel portion PA, and the transparent organic insulation material is filled in the bowl-shaped mountain-like portion OPAS1 defined between the concavity ALC1 of the projecting portion PJ1 and the transparent substrate SUB. As a result, a quantity of light taken out from the organic light emitting layer OLE can be increased and can acquire the high brightness without increasing a current quantity compared to the conventional structure shown in Fig. 6 and Fig. 7.

Fig. 4 is a cross-sectional view similar to Fig. 3 showing an essential part of the vicinity of one pixel of the organic light emitting element constituting an organic light emitting display device for explaining the second embodiment of the present invention. The planar constitution of the pixel in this embodiment is substantially equal to the planer shape of the pixel shown in Fig. 1 except for a shape of a projecting portion PJ2 having a trapezoidal shape in which a cross-section thereof perpendicular to a

transparent substrate SUB having a concavity ALC2 formed in a pixel portion opens at the substrate side and a shape of a mountain-like portion OPAS2 having a trapezoidal shape in which a cross-section thereof traces the cross-section of the projecting portion PJ2. That is, in this embodiment, the shape of the concavity ALC2 of the projecting portion PJ2 which opens toward the transparent substrate SUB side has a flat portion at a center portion of a bottom surface of the concavity ALC2 and oblique surfaces which gradually enlarged toward the transparent substrate SUB side from peripheries of the center portion thus making the cross section perpendicular to the transparent substrate SUB have the trapezoidal shape.

The trapezoidal projecting portion PJ2 of this embodiment is formed of the multilayered structural film consisting of an anode EA, an organic light emitting layer OLE and a cathode EK which are stacked on the mountain-like portion OPAS2 of a transparent organic insulation material being a concavity ALC2 having a trapezoidal cross section. In Fig. 4, an emitted light from one point P of the organic light emitting layer OLE includes a direct light Lm which is directly irradiated from the transparent substrate SUB, a reflection light Lr1 which is irradiated from the transparent substrate SUB after being reflected on the cathode EK which constitutes an upper reflection electrode, and a multiple reflection light Lr2 which is irradiated from the transparent substrate SUB after being reflected a multiple times on the cathode EK and the anode EA which constitutes a lower transparent electrode. In this manner, the substantially whole emitted light from one point P of the organic light emitting layer OLE is taken out from the transparent substrate SUB.

Further, as can be clearly understood from Fig. 4, an area of the multilayered structural film which constitutes a light emitting layer of the pixel which is formed of the concavity ALC2 and the trapezoidal projecting portion PJ2 is broadened compared to an area of the conventional light emitting portion explained in conjunction with Fig. 6 and Fig. 7 in which the multilayered structural film of the pixel has a planer shape parallel to

a surface of the transparent substrate SUB. Accordingly, the area which contributes to the emission of light is substantially enlarged. That is, although the area of the pixel portion PA in a plan view may be equal, the substantial light emitting area is enlarged. Here, although a single trapezoidal projecting portion PJ2 having the concavity ALC2 may be formed in the inside of the pixel, it is preferable to provide a plurality of projecting portions PJ2 in view of the uniformity of brightness in the inside of the pixel. Particularly, to prevent the degeneration of the organic light emitting layer OLE caused by undesired substances such as moisture from the organic insulation layer which is formed in the concavity ALC2 of the trapezoidal mountain-like portion OPAS2, it is preferable to form a plurality of trapezoidal projecting portions PJ2 having a small planer area and to cover these projecting portions PJ2 with the anode EA made of ITO.

In this manner, according to this embodiment, the multilayered structural film which is constituted of the anode EA, the organic light emitting layer OLE and the cathode EK which is formed over the organic light emitting layer OLE is formed such that a plurality of trapezoidal projecting portions PJ2 which are projected to the side opposite to the transparent substrate SUB while having the concavity ALC2 of the trapezoidal mountain-like portion OPAS2 which is formed to be recessed toward the transparent substrate SUB side are formed in the inside of the pixel portion PA, and the transparent organic insulation layer OPAS2 is filled between the above-mentioned concavity ALC2 of the projecting portion PJ2 and the above-mentioned transparent substrate SUB. As a result, a quantity of light taken out from the organic light emitting layer OLE can be increased and the liquid crystal display device can acquire the high brightness without increasing a current quantity compared to the conventional structure shown in Fig. 6 and Fig. 7.

The shape of the concavity which can be used in the present invention is not limited to the shapes which are indicated in the above-mentioned respective embodiments. For example, the cathode EK may be configured such that the cathode

EK has a triangular shape, a polygonal shape, a conical shape or an elliptical-conical shape which opens at the transparent substrate SUB side or a shape which reflects the emitted light of the organic light emitting layer toward the transparent substrate SUB and fills a transparent insulation material in a concavity thereof. Such a cathode EK can obtain an advantageous effect similar to those of the respective embodiments.

The transparent organic insulation material which is formed to fill the above-mentioned concavity may be formed using an organic PAS film manufacturing process of a thin film transistor having a low-temperature polycrystal silicon channel. That is, using the transparent organic insulation material, the mountain-like portions (OPAS1, OPAS2) having a desired size are formed with high accuracy in such a manner that a solution of an organic material such as acrylic resin or the like, for example, is applied to the transparent substrate SUB2 as the organic material by spin coating or the like and, thereafter, is subjected to pre-baking, mask exposure, development and post-development-baking (decolorization baking: post-baking). ITO is formed over the mountain-like portions OPAS1, OPAS2 as the anode EA, and the organic light emitting layer OLE is formed over the anode EA, and the cathode EK is formed as an uppermost layer.

As the specific example of the above-mentioned organic material, an organic material which is disclosed in Japanese Patent Publication 2893875 or a radiation-sensitive (photosensitive) material disclosed in Japanese unexamined patent publication 2000-131846 can be used. Further, in forming the bowl-shaped mountain-like portions similar to those described in the first embodiment of the present invention, the above-mentioned organic material is applied to the transparent substrate, a mask having a large number of openings corresponding to the above-mentioned mountain-like portions is arranged on the applied film with a given distance therebetween, and ultraviolet rays are irradiated by way of the mask. As a result, a gradient is generated in the intensity of the ultraviolet rays irradiated to the applied film

and hence, a bridging reaction is gradually weakened from a center portion to a periphery of each opening of the mask whereby, the bowl-shaped mountain-like portions having smooth surfaces can be formed.

Further, the trapezoidal mountain-like portion shown in the second embodiment of the present invention can be formed by either increasing the open area of the mask or increasing a distance between the mask and the applied film.

In this manner, the mountain-like portion made of the transparent organic insulation material of the present invention is formed prior to the film formation of the organic light emitting layer and hence, there is no possibility that the process for forming the mountain-like portion influences the material of the organic light emitting layer whereby the above-mentioned degeneration of the organic light emitting layer in the conventional example can be eliminated.

Fig. 5 is an explanatory view of an example of an equivalent circuit of one pixel of the organic light emitting element to which the present invention is applied. In Fig. 5, reference symbol GL indicates the scanning signal line, reference symbol DL indicates the data signal line and reference symbol CL indicates the power source line. In this circuit, the pixel is constituted of a first thin film transistor TFT 1 which is connected to the scanning signal line GL and the data signal line DL, a second thin film transistor TFT2 which is connected to the power source line CL and the organic light emitting element OLED, and a capacitance CP which is charged through the power source line CL. A pixel drive circuit is constituted of the first thin film transistor TFT1, the second thin film transistor TFT 2 and the capacitance CP.

The first thin film transistor TFT1 which is selected by the scanning signal line GL charges the capacitance CP in response to signal data applied thereto from the data signal line DL. An electric current is made to flow into the second thin film transistor TFT2 from the power source line CL in response to a charge quantity of the signal data charged in the capacitance CP and a light is emitted corresponding to an inflow current

value. A plurality of these pixels are arranged in a matrix array thus constituting a planar display element. The organic light emitting display device is constituted by incorporating a display control circuit which controls a pixel drive circuit and the like in a periphery of the display element.

The use of the organic light emitting display device of the present invention is not limited to a mobile phone or a portable information terminal (Personal Digital Assistants, i.e. PDA). That is, the organic light emitting display device can be also used as a display device of a personal computer, various monitors or a television receiver set.

As has been explained heretofore, according to the present invention, it is possible to enlarge the effective light emitting area by making the area of light emitting portion (pixel) formed of the organic light emitting layer larger than the area of the pixel region and, at the same time, it is possible to effectively take out the light emitted from the light emitting layer to the transparent substrate side whereby it is possible to provide the organic light emitting display device using the organic light emitting element which can exhibit the high brightness with a low current.